

It is considered that the training breakwaters above referred to would produce, when fully executed, a depth of 12 feet at low water of spring tides in the entrance, being equal to 15 feet at low-water neap tides, 20 feet 8 inches at high water of those tides, and 23 feet 4 inches at high water of spring tides. In considering the net navigable depth in the entrance of this river, an allowance of 6 feet should be made for "scend," or wave-undulation, during heavy weather, and of 3 feet for clearance under the keel, so that vessels drawing up to 14 feet would be able to enter the Buller during an onshore gale at spring tides; whilst during fine weather the full draught of 23 feet 4 inches at high water of spring tides, and 20 feet 8 inches at high water of neaps, less, say 2 feet for clearance under the keel, would be available for navigation purposes. Having regard to ordinary conditions, it is not desirable to provide for a less ultimate depth in the entrance than that above stated, and therefore works of less length cannot be relied upon to produce altogether satisfactory results. Moreover, by placing the entrance in this depth it will be less subject to fluctuation from disturbance of the bottom in consequence of wave-action, than if formed in shallower water.

Should the requisite funds not be forthcoming for the construction of the two breakwaters in their entirety, which is not improbable, then any works which may be undertaken with a view to increase the depth on the bar ought to be executed, as far as it may be practicable to carry them, upon the lines laid down on the drawings which accompany this report, so that they may be extended hereafter, with a view to the ultimate attainment of the permanent deep-water entrance to the Buller which I have described.

Drawing No. 3 shows in full detail the character of the works proposed. It will be seen that they are intended to consist mainly of *pierres perdues*, the inner portions, where not exposed to the full stroke of the sea, being deposited from "end" and "side-tip" waggons, as rubble embankments, whilst the outer or terminating lengths would be tipped from a suitable timber staging. The stone for both breakwaters would be procured from Fairdown Hill, about seven and half miles from Westport, and conveyed therefrom on a branch railway, about one and a quarter miles in length, connected with the main Government line. The stone at Fairdown is quartzose sandstone, in the form of boulders along the hill-side. The outer portions of each of the breakwaters over the lengths shown on the longitudinal sections, Drawing No. 3, would be coated with concrete blocks of 22 tons each, arranged "pell-mell" so as to protect the rubble from the wash of the sea. In this manner much less stone will be consumed than would be required for a mole entirely of rubble, and a more stable mound will be produced; moreover the judicious combination of concrete with stone will be more economical than if the latter material were alone employed.

Along the crest of the west breakwater there would be a rib of concrete-in-mass, deposited within frames *in situ*, as indicated on Figures 4 and 5, Drawing No. 3, in order to afford an approach to the small cast-iron lighthouse proposed to be erected at the end of that work. The outer end of the eastern breakwater, for a length of 1,000 feet, would be brought up only to half-tide level, with a view to provide for the more ready escape of flood waters; this length of low level mound might be reduced, if necessary, or be raised upon, should it prove from experience that the relief which it is intended to afford could be diminished or dispensed with.

Internal Works.

These consist of training banks of rubble stone, with their tops formed at half-tide level, commencing on the west side of the river, at a point opposite to 4,000 feet above Bentham Street, and extending seawards therefrom by lines of easy curvature in the position indicated by striped red color on Drawing No. 2. There would be an opening left in the western bank abreast of the entrance to the "Future Floating Basin" to which reference is made hereafter. The bank on this side would terminate at a point about 300 feet seaward of a line drawn from the commencement of the west breakwater, and distant 1,200 feet therefrom, so as to form a wave-basin for the dissipation of "scend" or undulation which might enter between the breakwaters during gales. On the east side the internal works would consist in joining up the existing wharves, and in constructing a half-tide training-bank seaward thereof, and parallel to the bank on the west side, so as to form, in conjunction with the latter, a low-water channel of 500 feet in width. The outer end of the eastern bank would finish at a point 1,200 feet seaward of the commencement of the eastern breakwater, and at a distance of 800 feet from that work, thus forming a wave-basin on the east side for a similar object to that previously described on the west side. There would be a small port light placed on the ends of each of the training banks for facilitating the entry of vessels at night.

Formation of Channel.

There cannot be a doubt that the execution of the external and internal works previously described will have the effect, by scour alone, of materially improving the depth in the channel opposite the town and seaward thereof. It is more than probable, however, that this scour would have to be supplemented by dredging; in any case it is desirable that the permanent bed of the channel should be formed at the level, and to the gradients, shown on the longitudinal section, Drawing No. 1. In the following estimate I have assumed that one-half the materials now overlying the bed of the proposed channel will be removed by scour, and that the remaining half must be dredged.